FOR THE COPY

(2)

Report on the

TECHNOLOGY BASE SEMINAR WARGAME II (TBSWG II)

Volume 1: Summary Report

AD-A231 060

16 November 1990

Editor
Sally J. Van Nostrand

Contributors
James R. Predham
E. James Gaul
Dennis R. Schmidt
Bruce M. Fonoroff
Kleber S. Masterson, Jr.
John R. Statz, Jr.
Raymond A. Haeme
Mark Herman
Robert J. Ryer

DTIC
ELECTE
JAN 23 1991
S B D

Booz•Allen & Hamilton Inc.
Bethesda, Maryland
23-26 April 1990

The Combined Arms Center
Training and Doctrine Command
Ft. Leavenworth, Kansas
6-8 June 1990

US Army Materiel Command
Deputy Chief of Staff for Technology Planning and Management
2800 Powder Mill Road
Adelphi, Maryland 20783-1145

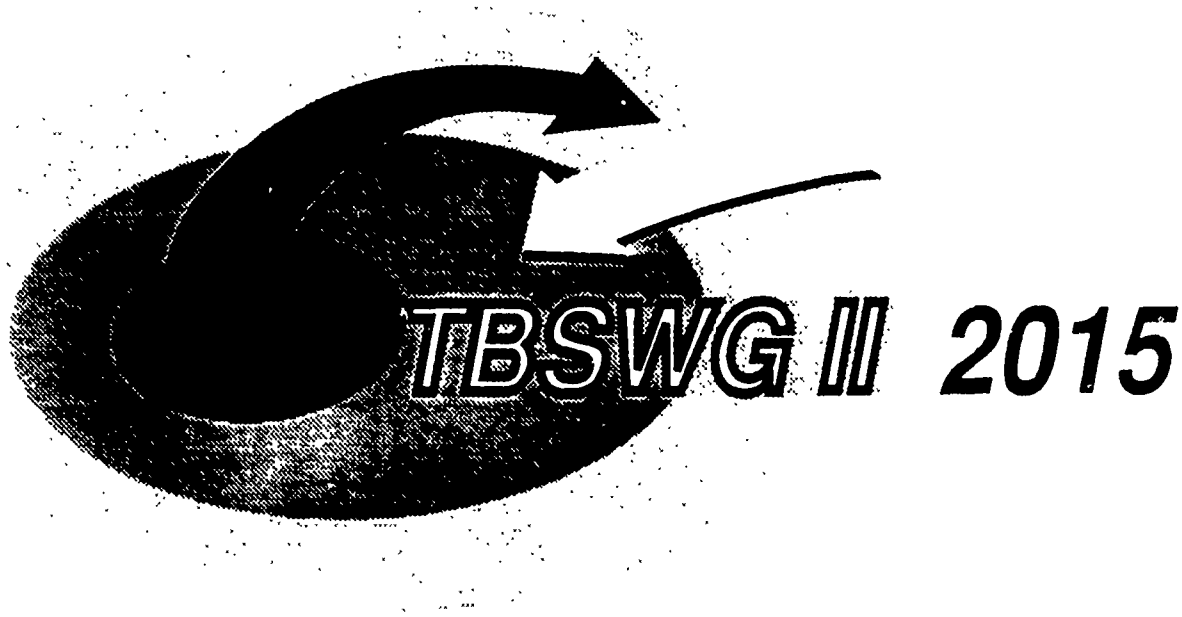
APPROVED FOR PUBLIC RELEASE
DISTRIBUTION UNLIMITED

Report on the

TECHNOLOGY BASE SEMINAR WARGAME II (TBSWG II)

Volume 1: Summary Report

16 November 1990



Booz•Allen & Hamilton Inc.
Bethesda, Maryland
23-26 April 1990

The Combined Arms Center
Training and Doctrine Command
Ft. Leavenworth, Kansas
6-8 June 1990

US Army Materiel Command
Deputy Chief of Staff for Technology Planning and Management
2800 Powder Mill Road
Adelphi, Maryland 20783-1145

THIS PAGE LEFT INTENTIONALLY BLANK

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Washington Headquarters Services, Directorate for information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	16 Nov 90	Summary

4. TITLE AND SUBTITLE

Report on the Technology Base Seminar Wargame II (TBSWG II) Volume 1: Summary Report

5. FUNDING NUMBERS

~~DAAL02-89-R-9014~~

DAALO2-90-C-0075

6. AUTHOR(S)

Van Nostrand; Predham; Gaul; Schmidt; Fonoroff; Masterson; Statz; Haeme; Herman; Ryer

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

Booz Allen & Hamilton Inc.
Bethesda, Md

The Combined Arms Center Training and Doctrine Command; Ft. Leavenworth, Kansas

8. PERFORMING ORGANIZATION REPORT NUMBER

N/A

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

US Army Materiel Command
Deputy Chief of Staff for Technology Planning & Management
2800 Powder Mill Rd.
Adelphi, MD 20873-1145

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

N/A

11. SUPPLEMENTARY NOTES

None

AMC extended the scenarios of the ALBF (Air-Land Battle Future) to consider technology capabilities anticipated by the year 2015.

12a. DISTRIBUTION/AVAILABILITY STATEMENT

Approved for Public Release

(Europe, Southwest Asia and Latin America)

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

The Tech Base Seminar War Game II (TBSWGII) was specifically designed to evaluate the applicability of emerging technologies. Three regional settings allowed game technologies to span across the spectrum of conflict, from low- to high-intensity warfare. Phase I, Concept Game, was held on April 23-26, 1990 in Bethesda, Maryland. Phase II, Equipping Game, was held on June 6-8, 1990 in Ft. Leavenworth, Kansas. Summary of results: the next war will probably be a sensor war; long range precision weapons will change our concepts of battle; the individual soldier will remain the key element for success, technology can provide the soldier with a critical "edge" in combat; our capabilities are strained by operations in urban terrain, minimization of collateral damage, and distinguishing friendly from enemy; it will still be necessary for the United States to effectively project ground forces to trouble spots anywhere on the globe. TBSWGII provided technologists and tacticians with a vision of the future battlefield.

14. SUBJECT TERMS	15. NUMBER OF PAGES	16. PRICE CODE
	45	

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	Unlimited

EXECUTIVE SUMMARY

"Efforts such as TBSWG II, in which soldiers and scientists work together to figure out how best to equip a smaller future Army, are important underpinnings of our Technology Base Investment Strategy."

Carl E. Vuono, General, USA, Chief of Staff

Technology Base Seminar War Game II (TBSWG II), sponsored by the Army Material Command (AMC) Deputy Chief of Staff for Technology Planning and Management, provided technologists and tacticians with a vision of the future battlefield. Phase 1, the Concept Game, was held in Bethesda, Maryland, on 23-26 April 1990, and Phase 2, the Equipping Game, at Ft. Leavenworth, Kansas, on 6-8 June 1990.

Three regional settings, Europe, Southwest Asia, and Latin America, were selected from the AirLand Battle Future (ALBF) umbrella concept to game advanced technologies across the spectrum of conflict, from low- to high-intensity warfare. AMC extended the scenarios, developed by TRADOC Combined Arms Center to assess ALBF in the 2004-6 timeframe, by 10 years to consider technology capabilities anticipated by the year 2015. The battlefield systems were selected from the Next Generation/Future Systems (NGFS) Sourcebook.*

SUMMARY OF RESULTS

The Next War Will Probably Be a Sensor War. The ALBF umbrella concept places a premium on knowing almost everything about a potential foe, from troop dispositions to the opposing commander's plans. To provide this information, an array of sensors, from real-time satellite down-links to long range RPVs to the old "Mark I eyeball" will be needed.

Long Range Precision Weapons Will Change Our Concepts of Battle . Weapons with the ranges and precision needed for ALBF are not available today, but the technologies which will make them possible are being developed. In each scenario, the players opted for such weapons, often in lieu of heavy forces, to fulfill missions that today would require direct fire weapons.

New Technologies May Allow Tomorrow's Soldier to "Be More Than You Can Be". The individual soldier will remain the key element for success on the battlefield. Technology can provide soldiers with a critical "edge" in combat, through advances in sensors, information processing, neuroscience and biotechnology. Even incremental improvements may be decisive.

* Next Generation/Future Systems Sourcebook, US Army Materiel Command and US Army Training and Doctrine Command, March 1990 (SECRET) AD-B146944.

Even in an Era of Enhanced Technology, Many "Old" Problems Will Persist. Operations in urban terrain, minimization of collateral damage, and distinguishing friendly from enemy will continue to tax our capabilities. The most difficult tasks to accomplish in each of the scenarios were hostage retrievals, whether the hostages were friendly non-combatants or oil fields. In hostage scenarios, we will require either extremely accurate weapons, or "weapons of mass *disruption*."

Nothing Works If You Cannot Get It There. As the Army's forward based forces are reduced in the world of 2015, it will still be necessary for the United States to effectively project ground forces to trouble spots anywhere on the globe. Rather than defining specific systems to solve these problems, the players considered new concepts that might provide improved deployability.

ENABLING TECHNOLOGY FOR AIRLAND BATTLE FUTURE

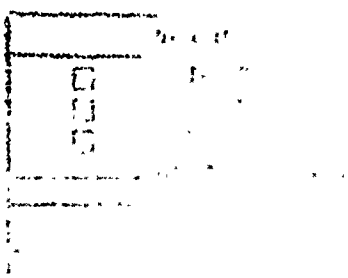
Since TBSWG II was specifically designed to evaluate the applicability of emerging technologies to the conduct of battles executed using the concepts of ALBF, it is no surprise that these technologies were key to their successful outcome. The issue is, then, "what technologies make ALBF concepts possible?" Although the set of emerging technologies identified by the Army were all required for the effective execution of the battles, several of them appear to be critical or enabling: Advanced Signal Processing and Computing; Low Observables; Neuroscience; and Biotechnology.

CONTENTS

Accession For
NTIS GRA&I ☑
DTIC TAB ☐
Unannounced ☐
Justification
By
Distribution/
Availability Codes
Dist | Avail and/or Special
A-1

QUALITY INSPECTED 4

THIS PAGE LEFT INTENTIONALLY BLANK



"Efforts such as TBSWG II, in which soldiers and scientists work together to figure out how best to equip a smaller future Army, are important underpinnings of our Technology Base Investment Strategy."

Carl E. Vuono, General, USA, Chief of Staff

Technology Base Seminar War Game II (TBSWG II) provided technologists and tacticians with a vision of the future battlefield. Phase 1, the Concept Game, was held in Bethesda, Maryland, on 23-26 April 1990, and Phase 2, the Equipping Game, at Ft. Leavenworth, Kansas, on 6-8 June 1990.

This volume of the final report is a summary which provides the most important parts of the final report in an unclassified format. More detail on all aspects is provided in Volume 2, the classified main report.

TECHNOLOGY BASE SEMINAR WAR GAMING

The Army Materiel Command (AMC) Deputy Chief of Staff for Technology Planning and Management (DCSTPM) sponsors technology base seminar war games. The purpose of these games is to bring material developers and users together to assess the value of technologies on the future battlefield. The results of these games are information sources for determining the Technology Base Investment Strategy. This strategy is documented in the Army Technology Base Master Plan.[1] The technology base seminar war games have two broad objectives: provide insights to the users on the potential value of emerging technologies; and provide technologists with an appreciation for the operational environment of the future battlefield.

In the first game, Technology Base Seminar War Game I (TBSWG I), the directors of the Army laboratories and technical directors of the Army Research, Development and Engineering Centers (RDECs) teamed with "warfighters" from the Training and Doctrine Command (TRADOC) to fight a high-intensity European conflict between NATO and Warsaw Pact forces in the year 2015. Fighting the war in 2015 challenged the players into thinking about the future and developing concepts to exploit technology beyond the constraints of programmatic thinking. The results of that game were published in an unclassified report.[2] The TBSWG I participants made these three major recommendations for future technology games:

1. Use other than European scenarios
2. Make Red more robust
3. Develop a reasonable resource constraint for determining the amount of advanced technology available to future forces.

In TBSWG I, weapon system attrition and forward edge of battle area (FEBA) movement were tracked on a personal computer, using the Theater Analysis Model (TAM)[3] developed by the Joint Chiefs of Staff. Based on an analysis of the model results generated in TBSWG I, it was decided that "pure" seminar war gaming would offer greater potential for creative system concept development, creating new warfighting concepts, and developing qualitative assessments. Quantitative assessments are more appropriate after the system specifications and operational use have been defined.

The objectives of technology seminar war gaming are creative stimulation and idea collection, rather than finite measures of effectiveness among competing weapon systems and tactics. Human experts engage in focused adversarial debate on the value of weapon system attributes and their concepts of application. Data is collected through notes and pre-designed forms to capture information determined by the game developers/sponsors. The outputs of this process include a recorded intellectual experience of a future war, insights on problems and solutions which are not apparent outside the game environment, and clarification of issues for further analysis.

Seminar war gaming is particularly useful in fostering an appreciation for the relative utility of emerging technologies. We expect these emerging technologies to provide technical advantages for US Army forces on future battlefields by providing enhanced capabilities for future battlefield systems.

TECHNOLOGY BASE SEMINAR WAR GAME II CONCEPT

In TBSWG II, the linkage of technology to user requirements was achieved through close coordination with the developers of the Training and Doctrine Command (TRADOC) AirLand Battle Future (ALBF) concept and consultation with Commander-in-Chief representatives from the regional conflict areas. Three regional settings, Europe, Southwest Asia, and Latin America (see Figure 1), were selected from the ALBF umbrella concept to game advanced technologies across the spectrum of conflict, from low- to high-intensity warfare. AMC extended the scenarios, developed by TRADOC Combined Arms Center (CAC) to assess ALBF in the 2004-6 timeframe, by 10 years to consider technology capabilities anticipated by the year 2015.

AirLand Battle Future (ALBF)

The TBSWG II assumptions about 2015 tactics and doctrine were drawn from the developing ALBF concepts. They are:

- Reduced force levels mean fewer forces fielded, leading to large "gaps" in the lines. These gaps cause a need for nonlinear fighting techniques

FIGURE 1: Three Operational Settings

- Maneuver and fire support forces are dispersed in noncontiguous areas and are not locked into a line of contact with the enemy
- Forces use technology (sensors, robotics, etc.), rather than forces, to locate, track, and acquire enemy targets
- Emphasis is on destruction of the enemy force rather than terrain retention
- Attack by long-range fires is always for lethal effects rather than for suppression.

TBSWG II Systems

TBSWG II used the nonlinear concepts of ALBF in Europe, Southwest Asia, and Latin America. The battlefield systems were selected from the Next Generation/ Future Systems (NGFS) Sourcebook.[4] This AMC/TRADOC-coordinated document is a compendium of advanced systems descriptions and their concepts for employment. We use NGFS to assess technology because we cannot determine the utility of technologies apart from the capability of a system enabled by technologies.

Simply stated, the Army does not field technology; it fields systems which provide battlefield capabilities to units and soldiers. In TBSWG II, opposing Red and Blue teams were given operational and tactical missions to accomplish using the NGFS they determined most appropriate for their tasks. The adversarial environment of opposing teams forced consideration of "true" capabilities, limitations of NGFS, and effective counters to advanced systems by a capable threat.

THE TBSWG 2015 WORLD

One of the objectives of the TBSWG process has been to assist the evolution of a better vision of how technology might change the nature of the battlefield. The magnitude of the change between the World Wars suggests that a war in the 1970's or 1980's ("World War III") might have been radically different from World War II. Similarly, the technologies addressed by TBSWG II appear to have the potential of making the 2015 battlefield ("World War IV") as different from a 1970/1980's battlefield as they might have been from World War II. This is particularly probable when the impact of new technologies is coupled with the impact of new doctrine such as that embodied in the AirLand Battle Future concept.

World Situation

All three scenarios and their vignettes were derived from this 2015 general world situation:

Diffusion of Power. Military, economic, and military power is diffused and neither the United States nor the Soviet Union has the same relative strength as in 1990. The ability of any single country to influence world events has been similarly reduced.

Diffusion of Military Technology. Military markets are no longer dominated by the US and the USSR. Japan, Germany, Israel, Brazil, France, and South Africa are now major suppliers of military goods and there are almost unconstrained sales of the latest technologies to the small and medium sized countries.

Nuclear Weapons. Nuclear weapons remain a major factor in political power. The United States and the Soviet Union each maintain small arsenals. More countries have nuclear weapons than 25 years ago. Rather than for use in general war, their value seems to lie in deterring enemy first use of nuclear weapons.

Regional Superpowers. A phenomenon of 2015 is the regional superpower, a country that dominates a region because of its economic and military strength. Japan is the regional superpower in Northeast Asia; Germany in Europe; India in South Asia; and Iraq in Southwest Asia. In Latin America, Panama has become a regional superpower, taking advantage of the economic strength that has come from US sponsorship and ownership of the Panama Canal.

Access to Energy Resources. Even back in 1990, access to energy resources was an important part of a nation's economic and political strength. Military strength has become an important dimension in the way nations have sought to maintain their access to energy resources.

Areas of Competition, Crisis and War. Three regions remain important to US vital interests: Europe (despite force reductions and alterations in alliances); Latin America (particularly in light of the shift in US emphasis away from Europe); and Southwest Asia (SWA).

The 2015 Battlefield

A vision of the 2015 battlefield is emerging from TBSWG II, but we note that history suggests that the evolution of the vision will be an extensive, iterative process that will require the best efforts of Army military and civilians, along with their industry counterparts, for the next decade or more. This caveat notwithstanding, we can outline our initial insights.

SUMMARY OF RESULTS

An analysis of the TBSWG II results provides the following major insights.

The Next War Will Probably Be a Sensor War

The AirLand Battle Future umbrella concept places a premium on knowing almost everything about a potential foe, from troop dispositions to the opposing commander's plans. To provide this information, an array of sensors, from real-time satellite down-links to long range Remotely Piloted Vehicles (RPVs) to the old "Mark I eyeball" will be needed. As the US will not have a monopoly on such sensors, we must take extraordinary measures to ensure that our dispositions and intentions are protected. In all scenarios, players used sensors and processors to locate key targets for long-range precision attack, and they found it necessary to use dispersion, camouflage, and obscurants to minimize enemy detection.

The scope of the sensor war will be vast. Information from many types of multi-spectral sensors, ranging from satellite-based to loitering unmanned air vehicles, along with human intelligence, will flow into artificial intelligence (AI) -based decision support systems to assist the commander in determining appropriate courses of action in the shortest time possible. This information cannot be limited to corps or division level, but must be pushed to all who need it. This implies robust communications networks and the ability of lower echelon forces to share information among themselves. Lower echelons also require sensors not required at higher levels — the ability to "see over the next ridge line."

Long Range Precision Weapons Will Change Our Concepts of Battle

Weapons with the ranges and precision needed for ALBF are not available today, but the technologies which will make them possible are being developed. In each scenario, the players opted for such weapons, often in lieu of heavy forces, to fulfill missions that today would require direct fire weapons. In the SWA scenario,

the Blue side used over 5000 of these weapons to eliminate the enemy's substantial tank army — while Blue was still in its assembly points. Precision weapons may, indeed, change our concept of offense. That is the intent of ALBF. But, since the US has no more monopoly on precision weapons than it has on other systems, precision weapons also imply an equally modified concept of defense. Dispersion and deception will help to confuse the enemy, but we must be able to defeat those weapons that are targeted correctly. Additional heavy, expensive weapons for a defensive role do not fit our assumptions of a smaller, lighter, but more lethal future Army. This role will require another class of precision munitions to protect our dispersed forces — small, light, and inexpensive.

New Technologies May Allow Tomorrow's Soldier to "Be *More* Than You Can Be"

The individual soldier will remain the key element for success on the battlefield. Technology can provide soldiers with a critical "edge" in combat, through advances in sensors, information processing, neuroscience and biotechnology. Even incremental improvements may be decisive — the ability to detect an approaching enemy 10 meters before he can see you in a jungle scenario may be all the difference that is necessary. Tomorrow's soldiers will be much more effective, not because the weapons are more lethal, but because they can apply them with greater effect. Advances in neuroscience and biotechnology will all but eliminate the effects of disease (a major factor in jungle warfare) while providing improved stamina and the ability to monitor individual soldier and unit effectiveness. Computer technology will provide the individual soldier with a portable knowledge base, to include language translation, decision support, fire control, position location, and communications. The selective use of powered exoskeletons may allow substantial nuclear, biological and chemical (NBC) and ballistic protection without reducing soldier mobility. Training and rehearsal systems will allow the soldier to plan and practice missions prior to combat.

Even in an Era of Enhanced Technology, Many "Old" Problems Will Persist

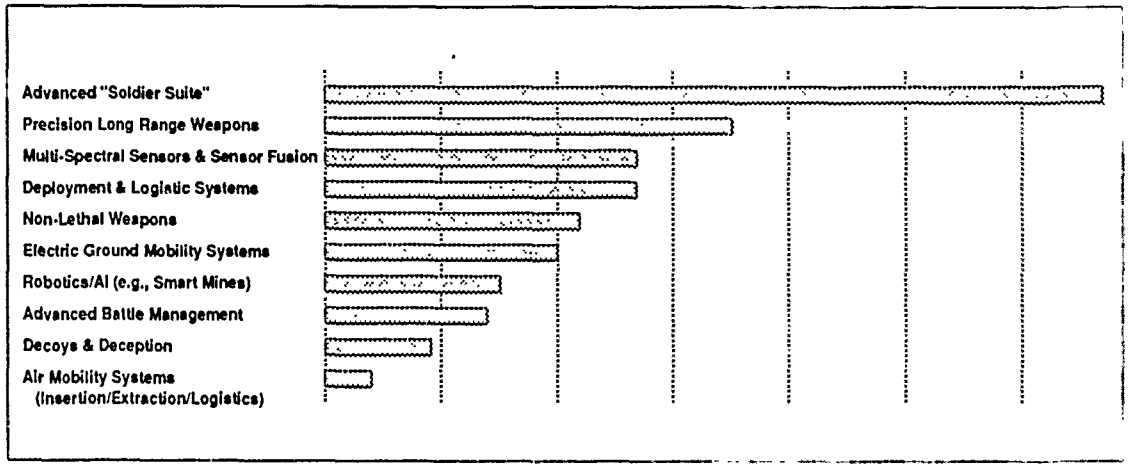
Operations in urban terrain, minimization of collateral damage, and distinguishing friendly from enemy will continue to tax our capabilities. The most difficult tasks to accomplish in each of the scenarios were hostage retrievals, whether the hostages were friendly non-combatants or oil fields. In hostage scenarios, we will require either extremely accurate weapons, or "weapons of mass *disruption*." The use of highly effective incapacitating agents appeared to be a practical weapon, allowing our forces to deal with an enemy while limiting loss of life to human hostages, local nationals, and collateral damage to infrastructure. A "dial-a-lethality" weapon — capable of stun through incapacitating to lethal effects — will provide needed flexibility to handle politically sensitive situations and real-time, world-wide televised warfare.

Nothing Works If You Cannot Get It There

As the Army's forward based forces are reduced in the world of 2015, it will still be necessary for the United States to effectively project ground forces to trouble spots anywhere on the globe. Rather than defining specific systems to solve these problems, the players considered new concepts that might provide improved deployability. The Army must work closely with the Navy and Air Force to insure that lift is available when it is needed. Even with the technological enhancements described above, a force capable of providing significant combat power is not "light." The Services must make a concerted, joint effort to guarantee the availability of essential transport, whether military or civilian. The Army's additional role is to develop computerized load planning, automated routing, and just-in-time-ports; design for transportability, self-deployability and ability to operate from shipboard bases; and design greater capability for a given weight or size.

Each of these insights, by itself, would cause only a small perturbation in the Army's technology investment strategy. Taken together, however, they offer a new set of vectors for our technology program. Technological and programmatic implications are described below, and the "Top 10 Systems" identified by the participants are shown in Figure 2.

FIGURE 2: Top Ten Systems/Capabilities



ENABLING TECHNOLOGY FOR AIRLAND BATTLE FUTURE

Since TBSWG II was specifically designed to evaluate the applicability of emerging technologies to the conduct of battles executed using the concepts of ALBF, it is no surprise that these technologies were key to their successful outcome. The issue is, then, "what technologies make ALBF concepts possible?" Although the set of emerging technologies identified by the Army (Figure 3) were all required for the effective execution of the battles, several of them appear to be critical or enabling.

Advanced Signal Processing and Computing

The focus of ALBF on long range detection and attack, and information distribution and analysis, make our efforts in this area decisive. Existing and planned systems, without substantial capability upgrades, will not allow the effective implementation of ALBF. These technologies also underpin the efforts of other emerging technologies (artificial intelligence, robotics, space technology, and, to a lesser extent, protection/lethality).

Low Observables

The inverse of the detection issue, investment in this set of technologies (along with protection) will allow our weapon systems to survive in the hostile environment of tomorrow's battlefield.

Neuroscience and Biotechnology

These two emerging technologies are key to many of the soldier enhancements postulated in TBSWG II. Investment in these areas will lead to the integrated soldier systems needed to succeed in the close battle.

FIGURE 3: Key Emerging Technologies

- Advanced Materials/Material Processing
- Advanced Propulsion
- Advanced Signal Processing/Computing
- Artificial Intelligence
- Biotechnology
- Directed Energy
- Low Observables
- Micro-Electronics/Photonics/Acoustic Devices
- Neuroscience
- Power Generation/Storage/Conditioning
- Protection/Lethality
- Robotics
- Space Technology

PROGRAMMATIC IMPLICATIONS

These findings provide an early look at our evolving vision of the future. Equally important are the implications of these considerations on the Army's technology base programs and organizations. Investment in the technology base today will provide mature system capabilities beyond the turn of the century. Therefore, we must evaluate our current investments in the light of our insights, and make appropriate modifications at the earliest possible date.

Soldier Enhancement

The enthusiasm which greeted soldier enhancement concepts was moderated by the relatively low level of visibility, funding, and priority. We believe that this is caused by the fragmented nature of the current program, and the small dollar value of each component. Stimulated by the results of TBSWG II, the Army is developing a Soldier Modernization Plan that will define a strategy for the acquisition of new individual soldier equipment. The technology base community will participate fully in the development of this plan, and must insure that the new concepts that evolved as part of the game are included in it. In particular, participation must not be limited to the usual components (food, clothing, and small arms), but must include those responsible for sensor, communication, neuroscience, biotechnology, and mechanical subsystems. The desired outcome is a structured technology plan to make possible the enhancements we used in the game.

Command, Control, Communication, and Intelligence (C3I)

The problem with C3I is not one of low visibility or funding, but the challenge of an overall architecture for sensors, processing, and communications. Such an architecture exists for Division and above, and for individual weapon systems, but the intermediate structure is extremely diffuse. The key to ALBF is the efficient delivery of information, tailored to the recipient, wherever it is needed. Current approaches focus on automating existing manual processes, and linking those processes that have always communicated. ALBF may require the Army to alter this paradigm, and technology developments are underway that will facilitate such changes. New operational and organizational concepts must be designed with enough lead-time to allow a smooth transition to them. Otherwise, the masses of available data could cause staff overload or lead to blind dependence on data received. Either would interfere with command decision processes. For all of these reasons, the Army must make substantial investments in modeling and simulation of new C3I concepts, and in specialized test beds to assess the implications of technology on command and control structures.

Logistics Research and Development (R&D)

The deployment problems encountered in the game highlight the area of logistics R&D. The present narrow definition of logistics R&D limits its scope to improvements in the logistics system itself. This is an important focus, but may miss the mark when future systems are considered. It may be more fruitful to consider the total force with a systems approach. Precision weapons, improved system efficiency and effectiveness, and reduced manpower requirements may have substantially greater impact on the logistics system than an improved forklift or fuel analysis system. The logistics experts should play a role in assessment of the entire Army, rather than setting priorities on a narrow group of technologies.

Heavy Forces

Deployment problems and the growth of precision long-range weapons may warrant another look at the current investment in heavy armored systems. The Army should study alternative structures that maintain survivability and lethality, while reducing lift and sustainment requirements. The findings provide a good starting point for such studies, as does the development of the ALBF itself.

THE TBSWG II PROCESS

Participants

TBSWG II players were Army technologists assisted by Air Force, Navy, and industrial technologists. Proponents for development of fighting concepts for the next century, the ALBF, from the Combined Arms Center (CAC) participated in TBSWG II planning and provided necessary ALBF expertise during the game. Players and advisors from TRADOC, US Army John F. Kennedy Special Warfare Center (JFKSWC), US Southern Command, US Special Forces Command (SOCOM), US Transportation Command, US Army Europe, and other Army agencies provided expertise specific to their commands.

Data Sources

Since the setting for TBSWG II was a hypothetical world in the year 2015 with mythical countries, there is no data base, history of the future, or Army field manual to turn to for data. There are, however, substitutes which depend upon expert judgement. Although these data are somewhat subjective, we believe that decisions based upon them are better than decisions based upon no data. The major sources are the Next Generation and Future Systems (NGFS) descriptions, player and advisor expertise, the developing concepts for ALBF, the hypothetical 2015 force designs, and scenarios developed for evaluating ALBF, as modified for TBSWG II.

Data Collection

Five types of data provided the information required for preparing this report: rapporteur notes; team leader briefings; synthesis panel notes; facilitator notes; and questionnaire results. All were used to determine the important systems for Phase 2 focus. Participants completed an evaluation questionnaire for each phase and, during Phase 2, completed a comprehensive survey on their view of the Technology Base Investment Strategy.

Scenarios

Three scenarios allowed players to consider three different types of conflict and three different types of terrain and weather. The scenarios are located in three familiar areas of the world for terrain and weather purposes. The Europe scenario represented the frequently studied high intensity conflict with heavy forces against a major power, while Latin America represented a low intensity conflict with insurgency and special forces in a small, undeveloped country. Southwest Asia (SWA) represented a mid-to-high intensity conflict. However, contrasted with the European scenario, SWA represented a contingency conflict in which all forces, equipment, re-supplies, and personnel must first be deployed while we assumed that some equipment and supplies were prepositioned in Europe. The scenarios were also differentiated by hypothesized technology levels: Europe, high technology not of US origin; SWA, high technology from all world sources, including the US; Latin America, generally less high technology-driven. Scenarios were based on those developed by CAC for 2004 to evaluate the ALBF, extended to 2015.

Phase 1: Concepts Game

The Phase 1 Concepts Game, exposed technologists and tacticians to operational requirements anticipated in the three conflict regions in 2015. Players were encouraged to use systems in the NGFS Sourcebook and to develop additional systems concepts, unconstrained by resources. The Concept Game provided technologists an opportunity to creatively apply emerging technologies to ALBF. In addition, it gave operational players and advisors an opportunity to think creatively about doctrinal solutions using potential new equipment. To focus their discussions, players used worksheets which showed some of the main tenets of ALBF matrixed with the battlefield mission areas (see Figure 4). They discussed which cells might be problem areas to determine where new ideas for equipment were most needed. During Phase 1, players discussed, but were not actually constrained during the creative process by realities such as technological risks, equipment acquisition costs, availability of deployment assets, and manpower support requirements.

Seventy-five players were divided into three regional seminar groups and then sub-divided into Red and Blue teams within the groups. The seminar groups rotated among the regions to gain three separate experiences. Furthermore, the technolo-

FIGURE 4: Issue by Battlefield Mission Area Matrix

		BATTLEFIELD MISSION AREAS							
					MANEUVER				
ISSUES		COMMAND AND CONTROL	INTELLIGENCE	FIRE SUPPORT	CLOSE COMBAT HEAVY	CLOSE COMBAT LIGHT	COUNTER MOBILITY/ SURVIVABILITY	COMBAT SERVICE SUPPORT	AIR DEFENSE
		1	2	3	4		5	6	7
KNOW WHERE THE ENEMY IS ALL THE TIME	1								
SENSOR FIDELITY	2								
INFORMATION FUSION	3								
RANGE OF COMMO	4								
RANGE OF FIRES	5								
PRECISION MUNITIONS	6								
RAPID MOBILITY	7								
RECONSTI-TUTE FORCES	8								

among the regions to gain three separate experiences. Furthermore, the technologists switched between playing Blue and Red so that they could create countermeasures to future systems and then the counter-countermeasures. In Phase 1, players identified more than 50 Blue systems as high leverage systems for 2015 for gaming in TBSWG II Phase 2 (Appendix K, Volume 4). Many of these systems are applicable to more than one of the gamed regions.

Phase 2: Equipping Game

The Phase 2 Equipping Game required the players to apply forces equipped with the NGFS identified during Phase 1 to specific battlefield missions presented in separate vignettes. Unlike computerized or computer-assisted wargaming, the vignettes were not sequential in time. For example, rather than discussing deployment first, the first vignettes were those which required the players to decide which equipment should be used. The players discussed deployment last, after they determined the forces they required in the theater. The forces were constrained by organizational design and deployment assets to represent real-world technological risk, acquisition costs, deployment problems, and manpower availability for specific contingency operations. Players were given the units available for the specific mission with a description of the numbers and types of equipment and units. Although they were not required to use that specific organizational design, they were not allowed to add either soldiers or units. If they decided that they needed

other equipment, they were required to give up an equivalent amount (by volume and weight) of other NGFS. Additional units were unavailable except as replacements for units given up.

Phase 2 used a three-day format which did not provide for the seminar group rotation concept used in Phase 1. Each seminar group remained in one region for all of Phase 2, and each player played only Red or Blue. Insights were shared during the out-briefs to expose players to challenges and solutions in all regions.

During the morning of the final day of Phase 2, the AMC Commander, General William G.T. Tuttle, was joined by the commanders of TRADOC, Forces Command (FORSCOM), and SOCOM and several other general officers for a short Senior Officer Southwest Asia Game. The brigadier and major generals played the Red side against the more senior officers playing the Blue side. A description of the game designed for the Senior Officer Game can be found in Appendix D, Volume 2. In the afternoon, the Chief of Staff of the Army, General Carl E. Vuono, joined the other general officers to review the regional team leader briefings.

Vignettes

For the Concept Game, the players used only the general types of warfare that could be expected in the region to determine the soldier and equipment concepts that might be useful in that region. During Phase 2, however, they were required to apply that equipment, now configured into units, to specific vignettes within a battle. The vignettes were designed so that each of the phases of a battle could be discussed as a discrete entity. Four vignettes were designed for each region in the expectation that the players might not have time for more than three of them. In fact, since the Latin America and Southwest Asia scenarios were more conceptually difficult than the Europe scenario, the players in those regions completed only three vignettes.

Of the four vignettes for each region, one was designed as a "special" vignette, covering a topic not discussed to the same extent in the other regions. All special vignettes were played. In Southwest Asia, deployment was the special topic, the individual soldier was the special vignette in Latin America, and reconstitution was discussed in Europe. In the deployment vignette, changes to equipment mixes within units and unit mixes within the force were constrained to remain within initial requirements for strategic lift (sea and air). The soldier system vignette was designed to focus technologists on developing enhancements for the individual soldier. The change here was not to man the equipment, but to equip the man.

LATIN AMERICA (LATAM) SCENARIO

The objective of the Latin America (LATAM) scenario was to focus the participants on requirements of special operations and low intensity conflicts in a mountainous rain forest where there is little infrastructure or host nation support and English is not spoken. Figure 5 summarizes the LATAM vignettes. The first two of the three Latin America vignettes focused on individual soldier systems.

Weather and Terrain

The conflicts occurred during the rainy season, degrading the ability of soldiers to move either on foot or by vehicle, and inhibiting the performance of most electronic systems. The first two vignettes were in a Central American rain forest, or jungle, and the third was in a heavily forested mountain region. The jungle has a hot tropical climate and conditions create special problems for maintaining operable

FIGURE 5: LATAM Vignettes

ACTIVITY / SCENARIO	Maneuver	Special	SOF
LATAM	Attack mech inf bde • Examine effectiveness of mobility systems. • Discuss lethal anti-armor systems. 3	Examine individual soldier systems • Examine soldier support systems. • Identify suite of soldier support equipment. 1	Hostage rescue • Examine insertion technologies. • Identify light weight disabling capabilities. 2

*Number denotes order in which vignette was played.

tropical climate and conditions create special problems for maintaining operable equipment. The effects on personnel of heat and disease in the jungle and altitude in the mountains must be considered.

The terrain in both regions afford many opportunities for concealment and cover, frequently restricts ground observation and fire, and makes ground movement difficult. Use of heavy infantry weapons, artillery, and other heavy combat weapons systems is limited.

Political Assumptions and Forces

Our ally, Boga, has been in a border dispute with Manyo for many years, and Boga has been attacked by Manyo in one sector of their common border. There is also an insurgency movement in Boga, not directly linked to Manyo. The insurgents employ terrorist activity and heavy handed recruitment when persuasion fails. Distinguishing insurgents from the rest of the population is a significant problem. The US forces in the LATAM scenario are small unit special forces or light infantry.

LATIN AMERICA VIGNETTE 1

The first vignette, a platoon movement to contact, was designed to examine individual soldier systems. It was played on a game board with miniature equipment, vegetation and soldiers. The objective was to visually display time and distance factors of jungle operations (e.g., difficulties of maneuvering forces through heavy vegetation; detection, command and control in dense vegetation; and degradation in unit strength caused by disease and non-combat injuries in this environment).

Two iterations of movement to contact were conducted, one using 1990 equipment and capabilities, and the second using 2015 capabilities. Complicating the platoon's mission was a lost friendly patrol operating somewhere in front of the platoon in addition to several small groups of enemy who were conducting harassing operations. After the major mission was completed, the platoon had to evacuate wounded and prisoners. The enemy force and the lost patrol were played by the controller.

Blue Concept

The Blue concept was developed by the Command neral Staff College (CGSC) and JFKSWC advisors. The platoon was to move in column through the jungle in the direction of the enemy force until contact was made. The platoon would then deploy to overcome opposition. The Blue force elected not to traverse the area on roads, thereby increasing their survivability but substantially decreasing the speed with which they could move.

In the 1990 part of the vignette, Blue set out security elements to the front, sides, and rear and attempted to move through the dense foliage.

Red Concept

The Red force deployed in small teams to harass and ambush Blue. The small teams were located in the vicinity of clearings and roads throughout the area.

LATIN AMERICA VIGNETTE 2

This special operations scenario was envisioned as a hostage rescue. However, at the request of and with the help of the SOCOM/JFKSWC Advisors, the scenario was modified to be more representative of an actual special forces operation. The exercise illustrated the concepts of insertion, sustainment, and extraction of small units. The special operations team was to be inserted, locate an insurgent training camp, observe for a specified period of time, and then be extracted.

Blue Concept

The Blue team elected to insert into the area of operations from a continental US (CONUS) sustaining base location. They would then move 10 kilometers (km) to the suspected insurgent training site and maintain contact for three days. Upon completion of the mission, they were to be extracted. When the team failed to locate the camp after three days because of Red countermeasures, the controller ordered the team stay an additional four days to continue searching.

Red Concept

The Red team decided to maintain two camps, one to train the critical people, and the second to serve as a decoy for the critical training operation. The more critical camp moved randomly and often, while the decoy camp moved periodically. The insurgents relied heavily on indigenous population for early warning of enemy actions and for sustainment of the camps. The Red force used a wide variety of high-tech sensors and decoys to protect the camps.

LATIN AMERICA VIGNETTE 3

This vignette consisted of a more conventional military mission: defense against a mechanized attack by the enemy forces through heavily forested and mountainous terrain toward the capital. The mission was to stop the mechanized enemy force from capturing the capital. The objective was to examine the effectiveness of counter-mobility and anti-armor systems.

Blue Concept

The Blue concept was to move from CONUS to Boga by air and then operate out of the international airport near the capital. Blue took advantage of national intelligence assets to locate the enemy forces and totally defeat them. They also took advantage of the wet terrain and the limited-to-nonexistent off-road maneuver capability to channel the Red force.

Concurrent with development of the Blue attack plan, Blue elected to reconfigure its forces. They eliminated the mechanized and anti-armor forces that were originally assigned from Corps assets and substituted heavily armed aerial forces, also available from Corps. The Blue force intended to use long range fires to disrupt and immobilize the enemy advance and to destroy large portions of the enemy's mechanized forces. The aviation forces would then be used to mop up the operation and insert troops for the final effort. A significant advantage to the Blue reconfigured forces was that a large percentage of the forces was self deployable, permitting the division to be inserted into the country much faster than a mechanized heavy force.

Red Concept

The Red force elected to attack on two axes toward the Boga capital, using two highway corridors from the southeast and south of the capital. The eastern axis was heavily weighted with armor forces because of better roads and better trafficability. The western force was somewhat lighter. The Red force made maximum use of psychological and disinformation operations. The Red force operated in a manner similar to the Blue ALBF concept. They would provide long range fires to disrupt the Blue aviation operations if possible.

Capabilities and Systems

The capabilities required to operate in the hostile jungle environment depicted by this series of vignettes were those that enhanced the abilities of the individual soldier. Although other soldiers operate mostly from armored and tactical vehicles and have the power sources available to operate soldier enhancement systems, the individual infantryman does not have a substantial power source available. However, the power sources constitute a critical component of the soldier enhancement system. Therefore, the enhanced capabilities must be extremely light-weight and have low power requirements.

The second major requirement of the soldier enhancement system is to provide intelligence about both enemy and friendly forces. In another environment, where soldiers operate within view of each other and with a general knowledge of what is in the vicinity, the requirement may not be as high. In this environment, however, soldiers are easily separated from each other, even over short distances, by heavy foliage and, therefore, have degraded movement and operational capability. Thus, a capability to fuse both enemy data and friendly location data can significantly improve morale and soldier effectiveness.

System Solutions

The major leverage in enhancing soldier performance appears to be provided by advances in neuroscience and biotechnology. Vaccines, diet supplements, sleep enhancers, and a better understanding of physiology, including the specific physiological benefits provided by adequate, sound sleep, were all determined to have major impact on improved individual soldier performance.

The systems required for the soldier enhancement include the soldier computer with biomedical sensors. The sensors will record the current condition of the soldiers and allow their physical and psychological capabilities to be assessed and enhanced. Part of the information needed to improve a soldier's psychological capability is knowledge of location of friendly and enemy forces. This information can be supported by the soldier computer system with a system to inter-net the individual soldiers' computers into a squad/platoon/company local area network (LAN) environment.

An additional requirement of small unit operations is the ability to insert, sustain, move, and extract forces. This capability should be stealthy so that small forces are not easily identified and located by potential enemies. Among the capabilities that would support these operations are language translators to permit the forces to communicate with indigenous personnel, and incapacitating agents which prevent the forces from being identified in the area — confusing the indigenous population so that they do not realize that our soldiers have been inserted or extracted in the area could be as effective as killing all observers. It would certainly be more politically acceptable.

Small unit performance can be substantially enhanced by rehearsal systems so that operations can be tested prior to execution.

The availability of strategic and tactical sensors and sensor fusion capabilities to identify enemy forces and provide location of friendly forces is a major issue. One of the players stated repeatedly that a Blue force detection advantage over the enemy of only 10 meters could provide an enormous tactical advantage when operating in close terrain.

The difficulty of foot soldiers moving through vegetation was also discussed. There was mixed opinion as to whether exoskeletons would make this problem better or worse. In any case, the players felt that the exoskeletal technology would not be available in the time frame and the movement problem was not resolved during the game.

Other capabilities and systems that were discussed were the inter-netted anti-armor and the anti-helicopter systems. These would allow defense of small units as they are moving through the terrain and at the same time encourage the enemy in the area to operate at altitudes where their advantages would be mitigated.

The systems or capabilities important to the LATAM scenario are:

- Sensors: strategic, tactical, and personal
- Information Fusion/Distribution: strategic, tactical, and personal
- Future Soldier System
- Physiological Preparation
- Smart Networked Anti-Air and Anti-Vehicle Mines
- Anti-Tank Helicopter Munitions
- Long-Range Missiles

Countermeasures

The use of indigenous population to detect and report the existence of small units constituted the primary countermeasure used by the Red force. Thus any system that provides for stealthy operation would be an enhancement. The local area network may be among those systems that can be easily countered. Decoys could provide a very high pay-off for the threat.

SOUTHWEST ASIA (SWA) SCENARIO

The objective of the Southwest Asia (SWA) scenario was to present players with one of the most stressful of potential requirements for US forces. In SWA, players faced a large and organized enemy force, equipped with modern heavy weapons. To reach SWA, US forces must deploy over a very long distance (15,000 miles) to a theater with no forward deployed forces, a small allied force, and very little host nation infrastructure. Figure 6 shows the vignettes discussed in SWA.

FIGURE 6: SWA Vignettes

ACTIVITY / SCENARIO	RSTA/LRF	Maneuver	Special
SWA	Destroy enemy long range fire units • Examine sensor/ fires integration. • Discuss deceiving enemy sensors. 1*	Attack enemy mech bde defending oil facilities • Breach barriers. • Counter enemy LRF. • Material disabling technologies. 2	Conduct strategic deployment (unopposed) • Examine force trade offs. • Identify enabling technologies. 3

*Number denotes order in which vignette was played.

Weather and Terrain

The SWA region presents a very hostile environment for the introduction of US forces. The hot and arid climate is similar to US deserts. However, the region presents unique problems. The sand in some parts of the region is much finer grained than the sand in most US deserts. During the spring and summer, this powdery sand rises on convection heating currents to as high as 24,000 feet. This creates serious visibility problems and refraction problems for high technology sensor and imaging systems. The sand also poses special problems for turbine engines. At jet engine internal operating temperatures, the sand melts to form glass globules which have been observed on compressor blades and have been known to cause engine failure.

Unique atmospheric conditions in the area cause unusual phenomena in electromagnetic wave propagations. Hand held FM radios which normally transmit over a 5 kilometer range may transmit up to 75 kilometers (km). Troposcatter phenomena is inconsistent in the region and some transmissions in this mode are lost entirely.

The scarcity of water creates a challenging problem for supporting US forces. Annual rainfall in the desert is 2 to 4 inches. Reverse osmosis water purifiers are adequate in coastal regions, but there is little water available in the vast desert regions.

The terrain is also difficult to traverse. There are extensive modern highways that connect the countries along one coast, but few elsewhere. The sand areas are virtually impassable without these road systems; even tracked vehicles have difficulty transiting these regions.

Political Assumptions and Forces

Part of the Shattland forces have secured the border with Audialand from the coast to approximately 200km inland. The remainder of the force has assumed blocking and counterattack positions approximately 150km deep. Long range artillery and missile units have been emplaced in field fortifications as well as urban areas, positioned to provide coverage well forward of defensive positions. Radio electronic monitoring, as well as high altitude reconnaissance and friendly state satellites, provide intelligence on Audialand and US reinforcements.

SOUTHWEST ASIA VIGNETTE 1

This vignette required the players to consider the detection and long range fire problem posed by ALBF. The objective was for the players to:

- Examine the effectiveness of sensors, communications and fire systems integration
- Identify technical solutions for defeating enemy counterfire sensors and long range munitions capabilities to destroy enemy fire units

- Consider the implications of continuous enemy fire unit detection and targeting
- Identify technical solutions to deceive or suppress enemy sensors.

Blue Concept

Blue's concept was to combine real-time, accurate, target tracking information with low-cost, lightweight, precision-guided rockets. Blue would first find the targets (potentially several thousand) using overhead satellites with multispectral sensors and a high speed AI processing system. Having located and tracked the targets, Blue would launch a massive missile attack, directing low-cost, lightweight, precision guided munitions at each of these targets in rapid succession. There can be few wasted shots. Blue calculated that a $50K per copy tele-operated missile could be produced weighing less than 300 pounds. Fifty sorties of C-17s could deliver the necessary quantity of missiles.

Blue recognized several obstacles to accomplishing this mission. First, the most likely defenses would be jamming, deception and dispersion. To overcome these defenses, several capabilities would be necessary. Anti-jam communications links were considered essential. Multispectral sensors made decoying and deception extremely costly and difficult. Dispersion creates a severe demand on intelligence processing systems to find and track so many targets. Blue anticipated that a large scale, ultra-high speed processing capability would exist in this time frame.

The second set of obstacles involved the long distances for both deployment and intra-theater transit. In order to rapidly build up sufficient combat power, Blue recognized the need for long range precision weapons that are lightweight and compact for transportability.

Red Concept

Red's concept for preventing Blue from achieving his objective was two-fold. First, Red would use dispersion and deception to confuse and overload Blue's intelligence gathering and processing system. Since people are low-cost to this Red threat, small detachments can be positioned in a large number of decoy sites with gun or missile mock ups, or with light air defense weapons. Hostages might also be used. Second, Red would use preemptive measures. Red planned to mine harbors used for debarking Blue military equipment with smart mines. Red would also use persistent chemicals in harbors if mines failed or were neutralized. Red would let in the first fast sea-lift convoy and then trap it in the harbor to prevent reuse.

SOUTHWEST ASIA VIGNETTE 2

This vignette required the players to consider the maneuver problem posed by ALBF. The objective was for the players to:

- Examine effectiveness of mobility technologies to breach enemy barriers
- Identify technical solutions for countering enemy long range fires

- Examine potential for using non-lethal, materiel disabling technologies
- Consider the implication of defeating or deceiving enemy sensors.

Shattland forces composed of approximately one mechanized brigade defended an oil trans-shipment point. Although Shattland forces had been severely depleted by Blue fire strikes, this brigade remained fully capable and had close support fires as well as fires to cover barriers and minefields. One armored division in Shattland was mobilizing and expected to reinforce the brigade in seven days.

Blue Concept

Blue's concept for accomplishing the mission was to suppress Red long range fire and air defense and then insert highly lethal light forces from the air. Driven by the difficulty in deploying and maneuvering heavy forces, Blue chose to use light forces to attack the oil facilities. Two problems had to be solved:

- Making light forces lethal against heavy forces
- Protecting light forces against heavy forces.

Heavy maneuver forces moving over land, even at speeds of 50 to 60 kilometers per hour, are vulnerable to long range fires and can be slowed by terrain and mines. Since heavy forces were available, Blue planned to use them primarily as a feint and later as a link up force. To rapidly place maneuver forces on the ground they chose aerial insertion using low altitude precision landing systems.

In order to protect the air drop of forces, it was important to suppress all Red air defense and long range fire systems. Blue would use overhead satellite with multispectral sensors as well as HUMINT (human intelligence) collection to pinpoint targets. They also developed a concept for a GPS (Global Positioning System)-equipped "Handicam" HUMINT collection device to transmit video of targets to satellite relays.

To provide further protection for air dropped troops, Blue would use innovative incapacitating agents or devices. The important thing to note is that Blue wanted to do all it could to protect the light forces during the critical air drop phase. Once on the ground, Blue faced an enemy in a built-up urban area. Blue anticipated smart mines on buildings, snipers in buildings, tanks and barriers. To clear mines Blue used charged particle beam or high power microwave (HPM) weapons. To attack snipers, Blue envisioned a robotic vehicle which senses muzzle blast and quickly returns fire.

Red Concept

Red's concept for preventing Blue from taking the city was to use high technology defenses to stall Blue's attack before it started. Red attacked Blue electric tank recharging vehicles so that ground maneuver forces could not complete the

trip. Red also made extensive use of jamming to frustrate Blue's targeting of Red air defense and long range fires. Anticipating chemical attack, Red placed forces in protective gear. To frustrate Blue's desire to take back oil facilities, Red mined them.

SOUTHWEST ASIA VIGNETTE 3

This vignette required the players to consider deployment of forces to Southwest Asia. The objective was for the players to:

- Examine trade-offs in organization deployment sequence to provide the greatest force capability in the minimum time
- Identify technologies which enable rapid strategic movement of high leverage forces
- Consider implications of cube and weight consumption in relation to system capability
- Consider the implications of sustaining supplies on deployment sequencing.

The situation and mission were described to them as similar to the first vignette, except that Blue was required to deploy the contingency force to the region prior to any other action.

Blue Concept

In this vignette both the Blue team and the Red Team played the Blue role to deploy forces to the theater. The teams played independently and then compared approaches. The first Blue team's approach to deployment was to consider how technology could be applied to improving the deployment process. Several steps that require long term planning and development were identified:

- Extend maritime prepositioned stocks (MPS)
- Design all Army equipment for transportability: make lighter, reduce cube size to fit containers
- Establish deployment ports and air ports designed to optimize outloading
- Build 5th Generation Joint Operations Planning Evaluation Systems (JOPES) as a computer aided deployment system to optimize flow of units and supplies to ports, onto ships and aircraft and out of debarcation ports and airports
- Subsidize up to 1/3 cost of construction of adequate number of commercial ships and aircraft to be compatible with military requirements
- Use flexible manufacturing in theater to build equipment in theater
- Only ship raw materials (for selected commodities/spares).

The second Blue team's approach was similar to the first in most respects. This team differed in that they would use greater effort to obtain weapons / supplies and troops closer to the theater. For example this team chose to:

- Use pre-positioned weapons on MPS in nearby US bases
- Ship sustaining supplies from Europe
- Fly troops from Europe and US
- Requisition tanks from Audialand.

Capabilities and Systems

The Southwest Asia scenario highlighted the need to deliver highly lethal combat power to the far reaches of the globe starting from scratch. This scenario demonstrated that a number of developing countries had the national will and resources to build and use considerable military power. Since we cannot possibly preposition forces everywhere we might need them to defend our allies and interests around the world, we must be prepared to deploy them. When we face formidable combat power as hypothesized in this scenario, we must be able to quickly dispatch the most efficient force capable of defeating that enemy.

The Blue team quickly recognized this fact while playing through the scenario. As a result, they chose forces and system capabilities which could be brought to bear against the enemy as quickly and efficiently as possible. While the friction and fog of war may have prevented them from operating as rapidly as they envisioned, their overall concept seems likely to succeed.

System Solutions

The systems and capabilities which provided the most leverage toward accomplishing this objective are:

- Tele-Operated Light Missile
- Multispectral Sensor System
- Real-time Battle Management System
- Light Satellite/Launch Capability
- Precision Air Drop Systems
- Future Soldier System
- Air Defense
- Improved Deployability.

Countermeasures

In the Southwest Asia scenario, Red gained considerable leverage from relatively low cost/low commitment actions. Blue's deployment difficulties were severe. If Red chose to oppose or even harass Blue's deployment, he could easily frustrate Blue's efforts by attacking ports and airfields with conventional or chemi-

cal munitions and by mining these facilities or approaches to them. Post-deployment, Red's most effective countermeasure was dispersion. Large numbers of forces widely dispersed in small groups present an extremely challenging problem in detection and tracking of targets. Red may also resort to hostage-holding and nuclear or chemical blackmail. Either of these actions also present Blue with a considerable challenge. Prevention is perhaps the only solution.

EUROPE SCENARIO

The Europe scenario examined the implications of advanced technology against an opponent similarly equipped where neither side had a significant technological advantage. The high intensity tempo of combat operations was characterized by significant use of sensors, command and control (C2) fusion, ordnance and high demand for logistical support.

In the basic scenario, Red forces cross the border in an attempt to swiftly traverse and occupy Amberland. The Blue forces were tasked to oppose this occupation and reestablish the original border by ejecting the Red forces. The vignettes considered in the European scenario are summarized in Figure 7.

Weather and Terrain

The European scenario was fought during January of 2015, in winter temperatures that remained around the freezing point. Most daylight hours were foggy, with low cloud ceilings. These conditions affected the air war significantly as only fourth generation and later aircraft could function effectively. The effects of cold weather on equipment and personnel was considered in all deliberations. The terrain of Europe in this timeframe was highly urbanized. Most combat was expected to be in the proximity of the urban sprawl, consisting of metal and concrete structures in medium to high density.

EUROPE VIGNETTE 1

The Blue Players were asked in this vignette to:

- Examine requirements for sensors, communication and fire systems integration
- Discuss technical solutions for continuous detection, tracking and targeting of enemy forces
- Identify technical solutions to increase firepower effectiveness in less time than comparable enemy systems
- Consider implications of enemy deception and intercept of friendly sensor and information data

FIGURE 7: Europe Vignettes

ACTIVITY / SCENARIO	RSTA/LRF	Maneuver	Special	SOF
Europe	**Defeat attacking enemy recon bde** • Examine effectiveness of sensors. • Discuss tech. solutions for detect/tgt'ing and military ops in urban terrain 1*	**Attack enemy mech bde on move** • Achieve mobility advantage over enemy. • Identify most lethal killing systems. 4	**Reconstitute US mech bde** • Reduce CSS requirements. • Identify CSS requirements of high tech systems. 2	**Destroy command and control** • Examine location capabilities. • Examine C3 destruction systems. 3

*Number denotes order in which vignette was played.

- Examine requirements and capabilities for conducting military operations in urban terrain, including detection and reduction of enemy defenses with minimal collateral damage.

Blue Concept

The Blue team utilized Reconnaissance, Surveillance, and Target Acquisition (RSTA), including space, ground, Unmanned Aerial Vehicles (UAV), and Joint Surveillance/Target Acquisition Attack Radar System (JSTARS), to detect enemy forces, and employed a deception battalion to create a false maneuver target to draw off enemy long range fires while conducting their own long range fires to destroy enemy first echelon forces. One of Blue's first priority tasks was to eliminate or suppress enemy satellites with antisatellite weapons (ASATs) and jamming to reduce Red intelligence and targeting information. After this preparation, Blue intended to have the mechanized division maneuver elements attack Red first echelon forces. After the battle, Blue maneuver forces were to resupply.

Red Concept

The Red team used the city to shield their forces from long range fire while some elements of a reconnaissance regiment moved forward to help identify Blue targets for Red long range fires. They would use chemicals and mines to create a barrier on the border, refreshing the barrier in the afternoon when the temperature drops. In addition, Red created a deception to convince Blue that their main units were heading into the city. The second echelon was to quickly enter the city and disperse so as to avoid becoming a lucrative target for Blue long range fires.

EUROPE VIGNETTE 2

The players were to discuss the potential of achieving a mobility advantage over the enemy and identify their most lethal killing systems and weapon types. The players were also to discuss the implications of high speed maneuver warfare and identify technical solutions for increasing the mobility of maneuver forces while maintaining armor-defeating lethality.

Blue Concept

The Blue team used a deception battalion to create the illusion of a force to the south of the city, so that the Red forces would go north while creating a barrier with smart mines to block the southern approach around the city. Meanwhile, Blue armor forces moved west of the city in position to launch a counterattack in cooperation with attack helicopters (which were to be moved forward for the purpose). Ex-oskeleton infantry (airmobile) with long-range anti-tank guided missiles (ATGMs) were inserted into the city to prevent Red forces from entering it, and mechanized infantry was moved into the woods north of the city to create a blocking force into which the counterattacking forces would drive the Red forces. UAV assets were used to maintain constant contact with enemy forces.

Blue was surprised to learn that Red, instead of advancing as anticipated, had gone over to the defensive to await the arrival of additional forces. The UAV assets gave a real time warning of this change in Red force posture. On the basis of this development, Blue revised their actions to maintain contact with Red forces using the UAV unit. To counter the unforeseen Red move, Blue organized a mobile battlegroup to launch a hasty attack and used long range fires to attrit enemy second echelon forces which were moving up to continue the attack through the first echelon positions.

Red Concept

The Red plan, in contradiction to their orders, was to have their attrited first echelon forces cease offensive operations and go over to the defensive while second echelon forces moved up to resume the offensive. This decision prevented Blue from springing their counterattack since Red did not cooperate by entering the trap.

EUROPE VIGNETTE 3

The players were tasked to examine potential ways of reducing Combat Service Support (CSS) requirements for heavy force maneuver systems. They were to identify CSS requirements of high technology systems most valued in heavy force maneuver warfare and identify technical solutions to reducing fuel, ammunition, and repair parts support requirements.

Blue Concept

The Blue team used the deception battalion to hide Blue intentions while employing long range fire to suppress enemy long range fires. The Blue CSS unit was moved up to the city with engineer support to overcome barriers emplaced by the enemy to thwart the effort, and the Blue maneuver brigade was to be reconstituted.

Red Concept

Use an anti-materiel barrier to prevent the CSS unit from arriving at the city. Use extensive sensor suites to identify the reconstitution locations within the city and use smart munitions to attack those sites.

EUROPE VIGNETTE 4

The players were tasked with examining technologies that could identify and locate a major unit headquarters. Also to identify material solutions for destroying enemy C2 systems quickly. Within this context, they were to consider the implications of long range communication, strategic insertion, and firepower coordination for "behind the lines" operations.

Blue Concept

The Blue team used special operation forces (SOF) to locate the Red command post and designate the lines of communication, and then called in space-base fire to destroy the command post.

Red Concept

Red had no specific concept except to defend the headquarters with ground and anti-air forces while maintaining the usual deception operations.

Capabilities and Systems

Intelligence gathering systems and the ability to deceive comparable enemy systems were seen as required capabilities because of the high lethality of the battlefield. The ability to block avenues of approach with smart mines without overwatch units was important due to the non-linear character of the battlefield. It was also felt that the ability to bring unstoppable firepower against important targets necessitated the use of space based strike systems.

System Solutions

The following systems were considered important to providing solutions to the problems posed in the Europe scenario.

- Systems
  - Deception and UAV (All vignettes)
  - Chemical Protection (Vignettes 1 & 3)
  - Exoskeleton (Vignette 2)
  - Electric Drive Tank (Vignette 1, 2, & 3) and Attack Air Mobility System (AAMS) (Vignette 2)
  - Space Strike System (Vignette 4)
- System Combinations
  - Real time intelligence, coupled with long range lethal fires, was the weapon of choice in the game
  - Deception units, coupled with smart minefields, gave both the illusion of a force and enough lethality to maintain the ruse
- The ability to forage power from forward locations was important as the distance that a force had to withdraw for reconstitution was prohibitive due to the long range fires
- SOF forces acted as the queuing system for the space strike system, which could not occur with UAV due to surface-to-air missiles (SAMs).

Countermeasures

Due to the fact that both sides possessed equivalent levels of technology and capability, most of the countermeasures used in this scenario were similar to the capabilities that they opposed. As a consequence, countermeasures were not unique to one side but, like deception, were used by both in the same manner. In all scenarios, both sides used human intelligence, rather than sensors, to defeat deception.

NEXT STEPS

The next steps for TBSWG are described so that planners from both operational and technology communities can better address questions of future capabilities and research programs. A number of issues were raised in TBSWG II which could be classified as showstoppers. Without further analysis, their impact in the context of one or more of the scenarios is open to serious question. A listing of these issues is given in Figure 8. Many of these issues surfaced in both TBSWG I and TBSWG II.

FIGURE 8: Issues for Further Analysis

- Value of "light" satellites vis-a-vis geostationary or high altitude systems
- Cost/operational effectiveness of a high/low mix of long range fires (guns versus missiles)
- Battle management automation role and mix
- Benefits and practicality of all-electric vehicles
- Novel concepts not explored:
  - Alternative fuels
  - Air cushion vehicle
  - Kinetic energy from space
- Role of directed energy
- Soil and foliage stabilization/destabilization
- Value and ability of non-lethal and anti-materiel degradation/weapons
- Logistics systems – deployment, sustainment
- Hostile environments
- Advanced soldier enhancements (exoskeleton and mobility)

Materiel fought on the battlefield of 2015 is predicated on successful Advanced Technology Transition Demonstrations (ATTD) and Technology Demonstrations in the first decade of the century, most probably the 2002-2007 timeframe at the latest. Thus, the next build of the field Long Range Army Materiel Requirements Plan (LRAMRP) — the budget development for fiscal years 1994 through 2009 — should budget research for those next generation and future systems which will appear in 2015. Many future system technology demonstrations will be candidates during the Extended Planning Annex (EPA) period (1992-2009); however, the 6.1 (basic research) solutions and 6.2 (exploratory development) solutions which lead to those successful demonstrations should already be funded or should be funded in the next Program Objective Memorandum (POM — FY94-99). It behooves planners, therefore, to pay close attention to the war gaming process and its insights so that modernization plans and technology programs can take advantage of the developing insights to the maximum possible extent. As a result of TBSWG II, the AMC technology community has already started working more closely with TRADOC in developing solutions to anticipated battlefield problems which include future systems.

Technology Base Strategy

Future systems definition is the key parameter for the technology base community. Constrained resources require diligent focusing of the 6.2 programs and, to a lesser but still vital extent, the 6.1 programs. Emerging technologies need to be continuously refocused to support the range of defined future systems which promise to produce the desired future capabilities.

Figure 9 shows the relative importance of each of our emerging technologies to the major TBSWG II insights. We are now collecting the data to show how much of our technology research money is spent in each of the cells. The next, and most

difficult, step is to determine whether those amounts are most appropriate or whether some should be increased. Unfortunately, with the present budget situation an increase in one cell must mean a decrease in one or more of the other cells.

FIGURE 9: Applicability of Emerging Technologies to TBSWG II Major Insights

MAJOR INSIGHTS / EMERGING TECHNOLOGIES	Soldier Enhancement	Sensors (and Info Fusion)	Long Range Precision Fires	New and Old Problems	Deployment and Mobility
Advanced Materials/ Material Processing	◒	◒	○	○	●
Advanced Propulsion			◒		●
Advanced Signal Processing/Computing	○	●	●		
Artificial Intelligence	○	●	◒		○
Biotechnology	●			◒	
Directed Energy Weapons	◒			◒	○
Low Observables	●		◒		●
Micro-Electronics/ Photonics/Acoustics	◒	●	◒		○
Neuroscience	●				
Power Generation/ Storage/Conditioning	◒		○		◒
Protection/ Lethality	◒		●	●	
Robotics	○	◒	◒	○	●
Space Technology		●	◒		

● Extremely important. ◒ Moderately important. ○ Somewhat important.

Cells containing no circles indicate that the emerging technology has little or no applicability to the insight area.

FUTURE GAMING

The results of TBSWG II contained in this report demonstrate the value of the seminar war gaming process. A significant number of new insights have been gained, and serious questions have been raised. The credibility of a number of the issues identified is enhanced when compared with similar concerns following TBSWG I. The biannual program planning cycle probably lends itself to biannual seminar war gaming as we have started it. The magnitude and scope of the next war game (say FY92) should be examined. An assessment of where we are, what we have learned, and what we need to focus on next is in order. Such an assessment should, in fact, be one of the first milestones in the TBSWG III planning. Initial thoughts on this process are provided in the Appendix to this Volume.

APPENDIX: CONTINUING THE SEMINAR WAR GAMING PROCESS

Issues/Analyses

The issues highlighted in Figure 8 need to be analyzed and white papers disseminated to the community. A re-examination of TBSWG I issues may provide additional white paper candidates.

Personnel Participating

Senior technology executives, directors of the Army corporate laboratories and directors of RDECs and other Army laboratories, were major players in TBSWG I and TBSWG II. These games seem to have been a worthwhile use of their time — some of the directors have already made changes to the Technology Base Investment Strategy as documented in the 1990 revision of the Army Technology Base Master Plan. We believe that other key members of the technology community should be exposed to the process. Therefore, we expect to hold other games which include chiefs of the centers' Advanced System Concept Offices (ASCO), plus directorate chiefs and other high level planners from the centers and laboratories.

The first game we are planning is a game focused on the long-range precision fires that seemed so important in TBSWG II. In this game, we will discuss the role and mix of the many differing types of fires that could be available in the future. Players will be drawn from the ASCO and directorates in the centers and laboratories that have a specific interest in this topic. We expect that the Field Artillery School will want to be involved. Since sustainability is an important issue that must be better addressed in the future, logistic planners will also be invited.

Future System Quality

The technology details of the Next Generation and Future Systems need to be improved. The ASCOs, with extensive support from the corporate laboratories, should expand the system alternatives for future war games, and they need to consider scenarios across the warfighting spectrum (Europe to Special Operations Forces). The showstoppers, issues, and "Top Ten Systems" in this report constitute a starting point for expanding thoughts about Future System candidates. The operational community should interact extensively in this process so that capabilities and ALBF concepts would add robustness to the range of Future Systems.

Emerging Technology Assessment

In February-March 1988, AMC conducted the milestone Technology Base Investment Strategy Conference (TBISC 88). The major goal was "the identification of future systems by which technologies can be translated into battlefield capabilities." TBSWG II and successful post-assessments will form the basis for a second AMC look at the emerging technologies. TBISC 88 influenced the FY90-97 technology base

plans. A re-examination of where the emerging technologies are heading, and to what extent refocusing should take place based on TBSWG II, is in order. Directed energy, enhanced soldier technologies, multispectral sensors, etc., and the attendant key emerging technologies are examples of areas which may have gained new insights and possible redirection.

TBSWG Planning Cell

The technical, operational, and administrative workload associated with exploiting TBSWG II and planning workload for a future game requires a dedicated cell(s) of personnel with ties into the operational and technology communities. A structure within DCSTPM and AMC needs to be identified, and a framework for all activities should be defined, including a plan for the exploitation of TBSWG II and the continuation of the process into the future (TBSWG III and beyond).

GLOSSARY

AAMS: Attack Air Mobility System.

AI: Artificial Intelligence.

ALBF: AirLand Battle Future.

AMC: Army Materiel Command.

ASAT: Anti-Satellite Weapon.

ASCO: Advanced System Concept Offices.

ATGM: Anti-Tank Guided Missile.

ATTD: Advanced Technology Transition Demonstration.

C2: Command and Control.

C3I: Command, Control, Communication, and Intelligence.

CAC: Combined Arms Center.

CGSC: Command and General Staff College.

CONUS: Continental United States.

CSS: Combat Service Support.

DCSTPM: Deputy Chief of Staff for Technology Planning and Management.

EPA: Extended Planning Annex (i.e., years 8 through 17 from current year).

FEBA: Forward Edge of Battle Area.

FORSCOM: Forces Command.

FY: Fiscal Year.

GPS: Global Positioning System.

HPM: High Power Microwave.

HUMINT: Human Intelligence.

JFKSWC: John F. Kennedy Special Warfare Center.

JOPES: Joint Operations Planning Evaluation Systems.

JSTARS: Joint Surveillance/Target Acquisition Attack Radar System.

Km: Kilometer.

LAN: Local Area Network.

LATAM: Latin America.

LRAMRP: Long Range Army Materiel Requirements Plan.

MPS: Maritime Prepositioned Stocks.

NBC: Nuclear, Biological, Chemical.

NGFS: Next Generation and Future Systems.

POM: Program Objective Memorandum.

R&D: Research and Development.

RDEC: Research, Development, and Engineering Centers.

RPV: Remotely Piloted Vehicle.

RSTA: Reconnaissance, Surveillance, and Target Acquisition.

SAM: Surface to Air Missile.

SOCOM: Special Forces Command.

SOF: Special Operation Forces.

SWA: Southwest Asia.

TAM: Theater Analysis Model.

TBISC: Technology Base Investment Strategy Conference.

TBSWG I: Technology Base Seminar War Game I.

TBSWG II: Technology Base Seminar War Game II.

TRADOC: Training and Doctrine Command.

UAV: Unmanned Aerial Vehicle.

REFERENCES

1. Army Technology Base Master Plan, Headquarters, Department of the Army, Director for Research and Technology, April 1989 (CONFIDENTIAL).

2. Warfighting with Emerging Technologies: Report on the Technology Base Seminar War Game, US Army Materiel Command Deputy Chief of Staff for Technology Planning and Management, June 1988.

3. Theater Analysis Model, v2.0, Joint Staff, J-8, March 1988.

4. Next Generation/Future Systems Sourcebook, US Army Materiel Command and US Army Training and Doctrine Command, March 1990 (SECRET) AD-B146944.

THIS PAGE LEFT INTENTIONALLY BLANK